Bacteriologic Comparison Between Epidural and Caudal Techniques

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Although there have been several studies of the bacteriologic aspects of epidural technique, 1–4 there is no study of caudal block. Moreover, many anesthesiologists refrain from using caudal analgesia because of fear of infection. 5,6 For these reasons we conducted the following study.

METHODS

The Human Research Committee of our hospital approved the protocol of the study, and the patient’s consent was obtained. The study consisted of two phases, including a total of 30 patients.

Phase I. Fifteen women of physical status I, ranging in age from 20 to 26 years, were in active labor, necessitating analgesia. In order to minimize the variables, epidural and caudal techniques were simultaneously used for all parturients (the double-catheter technique). 7 No rectal enema was given during labor. The back of the patient was cleansed by use of povidone–iodine (Betadine®) spray. After one minute of contact of the degemming solution with the patient’s skin, the fluid was removed with a sterile swab. For continuous epidural technique, autoclaved sterile epidural trays with disposable 91.5-cm 20-gauge Teflon® epidural catheters 8 were used. For continuous caudal technique, the same type of catheter was introduced after the insertion of a 16-gauge Teflon intravascular cannula into the caudal canal. 9 The skin at the entrance of the catheters was covered by sterile gauze dressings and carefully sealed by adhesive tape to prevent contamination of the area with blood, amniotic fluid, urine, or fecal matter. No bacterial filters were attached to the catheters. However, filter-needles® were used to aspirate the local anesthetics from the corresponding ampules to prevent introducing glass particles into the epidural space. A single sterile disposable syringe was used at each injection into either the epidural or caudal catheter. During the first stage of labor, 0.5 per cent bupivacaine was injected in therapeutic doses through the epidural catheter. To keep the number of injections equal, each time an epidural top-dose was administered, 1 ml of the drug was also injected caudally. During the second stage of labor, 2 per cent chloroprocaine was injected through the epidural and caudal catheters to achieve both abdominal and perineal analgesia.

In the recovery room, initial bacterial cultures were taken from the skin surface around the catheter’s entrance. The skin was then decontaminated using 70 per cent alcohol and allowed to dry. The catheters were pulled out under sterile conditions and cultures were taken from the fluid inside the terminal part of the catheter, from the terminal 2 cm of the catheter representing the segment that had been in the epidural space, and from the 2 cm of the catheter extending 0.5 cm from the skin entry, representing the segment that had been in the tissues. From each patient 16 cultures, both aerobic and anaerobic, were taken and incubated at 35–37 °C. For aerobes, the specimens were incubated on blood agar plates and identified 48 hours later by Gram-stain morphol-

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§ Desert Pharmaceutical Co., Sandy, Utah 84070.

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ogy and biochemical testing. For anaerobes, the specimens were incubated anaerobically for 48 hours using the GasPack® System.** The morphology of the organisms isolated was described. The cultures were transferred to chopped mean–glucose–broth medium. Twenty-four hours later, the acids liberated in the broth were identified by use of liquid–gas chromatography. Thus, the genus of the isolate was determined. Biochemical tests were utilized to determine the species.

A single-blind study protocol was observed. Until the completion of the study, the bacteriologist was not aware whether the culture site was epidural or caudal, and the anesthesiologist was not informed of the laboratory findings.

The patients were repeatedly examined during their hospital stays for evidence of local infection at the site of entry, as evidenced by swelling, induration, redness, pus, severe local tenderness, marked pain, high fever, or rigor. Manifestations of deep infection as evidenced by motor or sensory changes in the lower limbs and/or marked limitation of movement of the back or lower extremity due to pain, spasm, or paralysis were also looked for. The patients were also contacted about 40 days after delivery.

Phase II. Fifteen other patients were included in this group. The study of these cases was similar to that in Phase I except for the skin preparation of the caudal area. The povidone–iodine spray was applied to the skin at both epidural and caudal sites, as described in Phase I, and after a minute the excess fluid was removed from the skin with a sterile swab. In the caudal area alone this procedure was repeated once and povidone–iodine ointment was applied at the skin–catheter interface.

Statistical Method. A statistical analysis of the data was based upon two variables: difference among groups in regard to subjects, and difference among groups in regard to bacterial cultures. For Phase I and Phase II separately, patients have been cross-classified according to culture positivity from cultures derived from caudal and epidural areas. The McNemar test† was utilized to test the hypothesis that subjects' differences in positive cultures from the two areas are equally likely; positive cultures of both aerobic and anaerobic organisms were considered separately. In addition, subjects were classified on the basis of epidural cultures alone, caudal cultures alone, or both, for Phase I and Phase II.

Finally, the differences between the positivities of cultures rather than subjects were used as a basis of comparison of the two areas and the two phases. The significance level was set at $P < 0.05$.

**Results**

Phase I. The duration of catheter insertion was $176 \pm 66$ minutes and the number of injections was $2.33 \pm 0.89$ times (mean $\pm$ SD). Two hundred and forty cultures were obtained. There was no correlation between the duration of catheter insertion or the number of injections and the number of positive cultures. Cultures of the fluid inside the catheter or the segments of the catheter in the tissues or the epidural space were all negative. Specimens from the skin surface in the caudal area produced a significantly larger number of positive cultures than did those from the epidural area ($P < 0.05$) (table 1). When positive cultures having only one colony were excluded because of the possibility of iatrogenic sources, the epidural technique was found to be completely sterile (table 1). The most common organism isolated was *Staphylococcus epidermidis*. Other saprophytes were diphtheroids and microaerophilic streptococci. In one culture from the skin at the caudal area, an obligatory anaerobe was identified as *Fusobacterium symbiosum*. *Escherichia coli* was not recovered.

In regard to the distribution of subjects having positive cultures, there was no statistically significant difference between epidural and caudal techniques in aerobic or anaerobic cultures (table 2). Follow-up studies of the patients showed the temperature to be normal except in four patients, three of whom had temperatures of 37.5°C, and the fourth a temperature of 37.8°C. The incidence of positive cultures was not higher in these patients than in the

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**Table 1. Phase I:* Numbers of Positive Cultures with Epidural and Caudal Techniques in 240 Cultures**

<table>
<thead>
<tr>
<th>Caudal</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Aerobic</td>
<td>Anaerobic</td>
<td>Total = 120</td>
<td>Aerobic</td>
<td>Anaerobic</td>
<td>Total = 120</td>
</tr>
<tr>
<td>Skin surface</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total after exclusion of positive cultures with one colony</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>5</td>
<td>9†</td>
</tr>
</tbody>
</table>

* Skin sprayed equally with betadine at both epidural and caudal areas.

† Statistically significant higher number of positive cultures as the skin surface with caudal than with epidural technique ($P < 0.05$).

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**GasPack® System by Becton, Dickinson & Co., Cockeysville, Maryland 21030.**
group as a whole. None of the patients received antibiotics. There was no evidence of clinical infection during the hospital stay or within 40 days following the use of epidural and caudal techniques. The hospital stay ranged from three to five days except for that of one patient, who had a postpartum tubal ligation and stayed for seven days.

Phase II. There was no evidence of clinical infection. If we exclude the positive cultures having one colony, all of the positive cultures were found in specimens taken at the skin sites (table 3). The number of positive cultures in Phase II was slightly greater than but not statistically significantly different from that found in Phase I. Like the situation in Phase I, the number of positive cultures for the caudal region was significantly greater than that for the epidural region. The skin saprophytes were the same as in Phase I. However, instead of Fusobacterium symbiosum, Escherichia coli was found in a specimen taken from one patient at the skin site in the caudal area.

In regard to the distribution of subjects with positive cultures, there was no difference between epidural and caudal techniques in aerobic cultures. However, the number of individuals with cultures positive for anaerobes was significantly larger with caudal than with epidural technique (table 2).

When Phases I and II were combined, there was no significant difference between epidural and caudal techniques in regard to subjects with positive aerobic cultures. However, there was a significantly larger number of subjects with positive anaerobic cultures in association with caudal than with epidural technique (table 2).

### Discussion

Local anesthetics are bacteriostatic or bactericidal, depending on the concentration and temperature. Povidone–iodine is a complex organic iodine preparation that is active against gram-negative and gram-positive organisms, aerobes and anaerobes, as well as fungi, viruses, protozoa, yeasts, and Mycobacterium tuberculosis. Most of the organisms are killed within 10 to 60 seconds of contact with the solution. It is a water-based solution; thus, it is devoid of the toxic and undesirable physical properties of iodine tincture. It does not cause irritation of the skin or the mucous membranes of the vagina or rectum.

Fusobacterium symbiosum is a normal inhabitant of body cavities, including the intestinal tract. It was probably found on the skin of the caudal area because of its proximity to the anal region. Escherichia coli is also a normal inhabitant of the intestinal tract and a common contaminant of the skin in the caudal area. All the other organisms detected were normal skin saprophytes.

In Phase I of the study, there was a higher incidence of positive skin cultures with caudal analgesia than with epidural technique. This finding stimulated us to conduct Phase II of the study, in which more scrupulous cleaning of the caudal area was performed and povidone–iodine ointment was applied at the skin–catheter interface in an effort to reduce bacterial growth. However, we were surprised to find that the number of positive cultures was still significantly higher in the caudal than in the epidural area. This can be explained by the fact that when the skin has been

### Table 2. Distribution of Subjects in Relation to Sites and Positive Cultures

<table>
<thead>
<tr>
<th></th>
<th>Number of Subjects with Positive Cultures</th>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Epidural Only</td>
<td></td>
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<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Aerobic</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>5</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Anaerobic</td>
<td>2</td>
<td>2</td>
<td>5</td>
<td>8</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Caudal Only</td>
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<tr>
<td></td>
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<td>3</td>
<td>3</td>
<td>9</td>
<td>13*</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Anaerobic</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

* Significant difference between epidural and caudal ($P < 0.05$).

### Table 3. Phase II,* Number of Positive Cultures with Epidural and Caudal Techniques in 240 Cultures

<table>
<thead>
<tr>
<th></th>
<th>Epidural</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Aerobic</td>
<td>Anaerobic</td>
<td>Total = 120</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skin surface</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total after exclusion of positive cultures with one colony</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td></td>
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</tr>
</tbody>
</table>

* Skin in caudal area sprayed twice as much as in epidural area, and Betadine ointment applied.

† Statistically significantly larger number of positive cultures and colonies with caudal than with epidural techniques ($P < 0.05$).
effectively degermed by scrubbing or by application of antiseptics, superficial organisms are eradicated; nevertheless, deep organisms begin coming to the surface. This process may have been accelerated by vigorous stimulation in Phase II. This observation strengthens a time-honored belief that it is not possible to completely eradicate organisms from the skin without destroying it. However, this finding should not discourage the anesthesiologist from preparing the skin before epidural or caudal analgesia, since the purpose is to kill the pathogenic organisms and to reduce the number of saprophytic organisms.

We conclude that anaerobic organisms are present on the skin in the caudal area. However, all bacterial cultures deep to the skin were negative and infection did not occur with either epidural or caudal technique. Metabolic care in preparing the skin site and the use of sterile techniques are recommended when using epidural and caudal blocks. Spraying the skin with povidone-iodine and removing the excess of fluid after one minute is adequate; repeating the procedure does not improve the technique.

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REFERENCES

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Dopamine for the Treatment of Spinal Hypotension during Cesarean Section

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Despite the use of prophylactic fluid loading1 and left uterine displacement,2 hypotension during spinal

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Key words: Sympathetic nervous system: dopamine; sympathomimetic agents, ephedrine. Anesthesia, obstetric. Complications: hypotension.

anesthesia for cesarean section continues to be a problem.3 When hypotension occurs despite these maneuvers, a vasopressor such as ephedrine must be administered.4 Dopamine appears to possess pharmacologic qualities that might be advantageous in this setting. It has a rapid onset and a brief duration of action and lacks alpha-adrenergic activity in low doses. In fact, in very low doses (2 µg/kg/min), dopamine has only dopaminergic action, including vasodilatation of renal and mesenteric vessels.5 It may also cause vasodilatation and improved perfusion in other splanchnic beds. Intermediate doses (3–12 µg/kg/min) cause primarily beta stimulation, and with more than 12 µg/kg/min, alpha effect may predominate.6

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